SEAWOLF SSN 21 CLASS ATTACK SUBMARINE AND AN/BSY-2 COMBAT SYSTEM

Navy ACAT IC Program

Total Number of Systems:	3
Total Program Cost (TY$):	$13185M
Average Unit Cost (TY$):	$2828M
Full-rate production:	N/A

Prime Contractor

General Dynamics Electric Boat Division-SSN 21
Lockheed Martin-AN/BSY-2 (V)

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2010

The SEAWOLF (SSN 21) Nuclear Attack Submarine was developed to maintain the U.S. technological lead in undersea warfare well into the 21st century. It is designed to rapidly deploy to militarily important hostile ocean areas and deny their use to the enemy, clear the way for strikes by other friendly forces, and engage and destroy enemy submarines, surface forces and land targets, supporting ***dominant maneuver*** as well as ***full-dimensional protection*** for afloat forces. Secondary missions are mine and special warfare. SSN 21 is designed to be a quiet, fast, heavily armed, shock resistant, survivable submarine, outfitted with the AN/BSY-2 Submarine Combat System.

The AN/BSY-2 Submarine Combat System is designed to support SSN 21 in all mission areas. It is required to track targets, platforms, and weapons. These characteristics will provide intelligence and

strike capabilities to support the Joint Force Commander in ***precision engagement*** as well as provide ***full-dimensional protection***. The combat control subsystem provides setting and control of weapons and mines, over-the-horizon targeting, combat systems management, and piloting and navigation functions. It includes the weapon launch equipment to support eight horizontal tubes, a vertical large screen display, and own ship data displays. More specific information is included in the classified version of this report.

BACKGROUND INFORMATION

The SSN 21 program began in 1982 and was approved for conceptual design in 1983. In December 1983, the preliminary design was authorized; it was completed in 1985. Approval for lead ship production was granted in 1988.

The DAB ADM for the SSN 21 Program Review decision of January 11, 1991, approved continuation of LRIP through completion of OT in FY98 (now scheduled for FY00). DOT&E's input to that decision was based upon an independent evaluation and assessment of projected performance of SSN 21. DOT&E identified several important aspects of performance without which SSN 21 may not achieve and retain the advantage over the projected threat. A detailed discussion of these aspects was published in the classified FY90 edition of this report. Performance changes due to programmatic changes to supporting systems are discussed in the FY95 Annual Report.

SSN 21's initial sea trials were delayed by concerns about the robustness of the titanium used in some of SEAWOLF's watertight integrity applications. This was partially resolved and SEAWOLF began initial sea trials in July 1996. On her second trial, a casualty to the Wide Aperture Array (WAA) sonar fairing occurred. The corrective action delayed delivery until mid-1997. Following delivery, USS SEAWOLF began acoustic trials, which were completed in November 1997.

SEAWOLF spent FY98 in post-delivery shakedown conducting Navy acceptance trials and some DT, entering a scheduled fourteen-month post-shakedown availability (PSA) at Electric Boat Company, Groton, CT, in August 1998. CONNECTICUT (SSN 22) began sea trials in September 1998. The first phase of CONNECTICUT's acoustic trials were completed in October 1998, and she spent most of 1999 in post-construction shakedown, entering drydock for PSA in August 1999. The third and final SEAWOLF class submarine, JIMMY CARTER (SSN 23) is still in construction, with delivery scheduled for December 2001.

The SSN 21 LFT&E program was initiated by an August 16, 1988 Decision Memorandum signed by the Secretary of Defense, which gave approval to proceed with production of the lead ship. This Decision Memorandum requested that the Secretary of the Navy provide a LFT&E plan to OSD within 120 days from the date of the memorandum. The Navy's LFT&E Plan for SEAWOLF was prepared on September 21, 1988. This plan placed heavy emphasis on live fire component and surrogate shock tests, and most significantly, a full ship shock test (FSST) of the completed ship. For ship safety considerations, the full ship shock test was to be conducted at a shock level intensity one half the SEAWOLF design operability shock level, at which the ship is required to retain full combat capability. The component and surrogate shock tests included underwater explosion tests with major SEAWOLF components installed realistically in large-scale surrogate test vehicles exposed to full design shock levels. The LFT&E strategy is shown in the SEAWOLF TEMP, and includes a Live Fire Test and Analysis Activities Matrix that lists major test and analysis activities and documents.

Past SEAWOLF LFT&E activity has included a ¼-scale Shock Model Test Vehicle underwater shock and hull whipping test of the submarine hull and the propulsor, completed in 1990; shock qualification testing of a TRIDENT (surrogate) shaft seal using the A/B-1 submarine shock test vehicle in 1990; and A/B-1 shock testing of a surrogate (General Electric) Main Propulsion Unit (with its associated Comparative Shock Analysis) and the WAA sonar fairing in 1995. An A/B-1 test series of major hull penetrations and related components began in 1998 and completed early 1999. (See discussion under Test and Evaluation Activity below). Testing of smaller hull penetrations has been performed using the Navy's Full Scale Section (FSS-5 and FSS-8) shock test vehicles and Paddlewheel shock test fixture. Extensive shock qualification testing of SEAWOLF internal vital components has been accomplished using Floating Shock Platforms (test barges) and standard Navy shock test machines. As reported in the current TEMP, approximately 5650 SEAWOLF components had been shock qualified, with 750 remaining to be qualified. In 1993, as part of its LFT&E program, the Navy developed the SEAWOLF Program Manager's Plan for Countering Secondary Casualties, associated with secondary weapons effects. Examples of secondary weapons effects are fire, smoke, toxic gases and flooding.

TEST & EVALUATION ACTIVITY

DOT&E approved Revision 4 to the TEMP in February 1999. This revision combined TEMPs for SEAWOLF and the AN/BSY-2 (V) Submarine Fire Control System.

At DOT&E's recommendation, COMOPTEVFOR conducted and completed a pre-OPEVAL OA of SEAWOLF. The OA focused on data and reports collected from the pre-PSA acoustic trials, the combined Weapons System Accuracy Trial and Launcher Trial, Tactical Development Exercises, and A/B-1 component shock testing. Integral with this OA, was the development of a coordinated data collection computer program to collect platform suitability data. This OA should aid COMOPTEVFOR's preparation of an efficient, effective OPEVAL test plan and help assess where SEAWOLF stands with respect to its overall preparedness for OPEVAL. COMOPTEVFOR signed out the final report on November 23, 1999. It is discussed below in the Test and Evaluation Assessment section.

Acoustic Trials continued in 1999 on CONNECTICUT, with results consistent with SEAWOLF. Further acoustic trials will occur in FY00 to evaluate SEAWOLF's acoustic performance with her anechoic coating installed. Weapons System Accuracy Trials (WSAT) and Launcher Trials were partially completed on CONNECTICUT in FY99. Concurrent with WSAT and other ship operations, the AN/BSY-2 Combat System Technical Evaluation continued.

In FY99, the Navy completed its SEAWOLF program-funded extensive series of underwater shock tests of the A/B-1 test vehicle at Aberdeen Test Center. Components tested included hull penetrations, hatches, weapons delivery system components, auxiliary launcher system assemblies, a periscope hull fitting and hoist cylinder assembly, boiler-type manways, and actuators for the depth control system hull and backup valves. Hatches that were tested included the bridge access trunk inboard and outboard hatches, the forward logistics escape trunk inboard and outboard hatches, and the weapon shipping trunk inboard and outboard hatches. Weapons delivery system components included a torpedo tube assembly with its breech and muzzle doors, air turbine pump, controllable air firing valve, turbine pump sea valve and operating linkage, as well as other valves, linkages and connectors. Congress had appropriated funds in FY96 to conduct the full ship shock test, which is the capstone test for certifying combat ruggedness of the ship class. The Navy elected to use those funds to help pay for correction of unforeseen problems with the fairing to the ship's WAA sonar. The Navy rescheduled FSST to FY00 and programmed additional funds to support FSST, but Congress explicitly removed the FY99 funds

allocated for preparations for FY00 FSST. The Navy has since deleted all SEAWOLF FSST funding from the Navy Future Years Defense Plan. DOT&E does not agree and has appealed the Navy's decision repeatedly.

Y2K testing of all shipboard systems was completed in FY99, with only very minor deficiencies observed. The SEAWOLF class is Y2K compliant.

TEST & EVALUATION ASSESSMENT

SEAWOLF's test program has been disrupted by several significant equipment/design problems. Although the number of deficiencies identified in the SEAWOLF program are not historically above normal, the nature of these deficiencies has significantly impacted the T&E program. FY00 should prove pivotal for the SEAWOLF class, as the ship should commence initial OPEVAL, which should complete in early FY01. In order to support the Navy's desire to deploy SEAWOLF as soon as possible, DOT&E concurred in a plan to tailor initial OPEVAL to address only the mission profile the submarine is expected to execute during the first deployment. The Navy's current plan includes using both SEAWOLF and CONNECTICUT as test platforms for parts of OPEVAL; however, both submarines' schedules are extremely ambitious, creating a potential conflict between completing the initial OPEVAL and deploying when now planned. FOT&E will subsequently be conducted before future SEAWOLF class deployments in other specific mission areas. JIMMY CARTER's unique configuration, which includes additional features supporting Special Warfare operations and lengthening the hull behind the sail and inserting an Ocean Interface section that will open larger payload apertures to sea, will also require FOT&E. More details are provided in the classified version of this report.

DOT&E believes that omission of the FSST places SEAWOLF's design combat survivability in question. Ship shock tests have historically revealed serious but correctable design deficiencies that component testing, modeling, simulation, or analysis did not detect. For example, the SEAWOLF component shock qualification program as written in the TEMP does not meet the Live Fire Test standards of another major shipbuilding program, the ARLEIGH BURKE (DDG-51). The DDG-51 program not only included component certification testing, it also included a Ship Shock Trial and a Total Ship Survivability Trial (TSST) in its Live Fire Test program. The TSST proved extremely valuable to the Navy because it helped train the Navy in how to fight the ship when hurt. It must also be noted that although the SEAWOLF Live Fire Test program qualified approximately 5,650 components, approximately 750 components remain unqualified. One of the major purposes the FSST serves is to provide some reasonable degree of assurance that all components acting together as a system of systems are reasonably threat challenged. The final dilemma facing SEAWOLF is that while the FSST is the centerpiece of the ship's Live Fire Test and Evaluation Strategy and its shock and survivability qualification, the Navy currently has not made the programmatic or financial commitment to make it happen, at the peril of the ship and its crew. This strategy had been mutually agreed upon by the Navy and DOT&E, and is contained in the TEMP. No alternative approach, including perhaps a TSST, has been formally proposed by the Navy.

During SEAWOLF's WSAT in FY98, the weapons launch systems demonstrated a significant class design deficiency that is described in detail in the classified version of this report. The Navy has designed and tested an engineering change that will be installed in all three SEAWOLF class hulls. Several other deficiencies, also described in the classified version of this report, have also been corrected. Due to these and numerous lesser material problems, the Navy's Board of Inspection and Survey will re-inspect SEAWOLF in FY00.

In FY99, DOT&E received and analyzed SEAWOLF's pre-PSA acoustic trial report. Details concerning DOT&E's conclusions are provided in the classified version of this report.

Although OPEVAL does not begin until FY00, AN/BSY-2 has performed as expected with an exception discussed in the classified version of this report.

Suitability issues of availability and logistics supportability remain unresolved due to late funding for critical spares and limited fiscal resources for engineering support and correction of major material deficiencies. Many SEAWOLF parts are already out of production, exacerbating this situation. The SEAWOLF class' maintenance will be expensive even if reliability goals are met.

The November 1999 Operational Assessment report cited six critical operational issues as high risk for SEAWOLF. These were: (1) covertness; (2) weapon launch, handling, and stowage; (3) detection; (4) tactics; (5) survivability; and (6) enhanced modular signal processor. The survivability risk is attributed to the lack of understanding caused by the absence of the Full Ship Shock Test, and COMOPTEVFOR recommends conducting this test. (More details on the reasons behind COMOPTEVFOR's risk assessment are found in the classified version of this report.) COMOPTEVFOR notes that there have been numerous failures in component-level shock tests. Once those failures have been corrected, a full ship shock test is justified to examine interfaces between components and system-of-systems issues. DOT&E agrees with this assessment, and notes that most of these concerns have been articulated to varying degrees in this report for the past several years. The Navy is striving to alleviate most of these risks in the long term, with the exception of survivability.

CONCLUSIONS, RECOMMENDATIONS, LESSONS LEARNED

Much important developmental and operational testing still needs to be accomplished before SEAWOLF initially deploys. In an effort to support the Navy, the operational testing is being tailored to not only assess critical operational issues, but also to support the ship's training needs. DOT&E is already observing schedule slippage that may tempt the Navy to choose to only partially complete the already limited OPEVAL if the SEAWOLF is to deploy when currently scheduled. (See the classified version of this report for the date.) Given the submarine force's reluctance to subject SEAWOLF to independent testing as evidenced by the avoidance of shock testing, we are very concerned that the OPEVAL will also be deferred. We consider it extremely important that SEAWOLF undergo a robust OPEVAL prior to deployment to ensure that SEAWOLF capabilities are fully understood and that there are no deficiencies that could impact mission safety. DOT&E will continue to work with the Navy to address these challenges.

Unanticipated problems arise in any acquisition program, and in a technologically complex program, such problems are to be expected. The difficulty with WAA fairing led first to the delay, and eventually the cancellation of the full ship shock test. The SEAWOLF program needs to be sure that new difficulties that arise in one area; e.g., torpedo launch at high speed, do not cause important tests to be canceled in other areas.

The classified version of this report makes several comments concerning the effects that the cost cap has had on SEAWOLF.

For the first time, the A/B-1 testing experience demonstrated a particular benefit of the Aberdeen Test Center's Underwater Test Facility. When conducting a long duration test series that would not be feasible or cost effective at sea, the A/B-1 test series enabled the identification of shock deficiencies and

subsequent development, incorporation, and successful testing of related design changes, confirming a satisfactory correction of the shock deficiencies. The Navy has assured DOT&E that it intends to implement the design changes developed through A/B-1 testing in all SEAWOLF Class submarines. In one case, a problem encountered with the SEAWOLF torpedo tube breech door shim installation serves as an example of the lessons learned from the A/B-1 test series. Under operability level shock loading during one shot, the torpedo tube breech door underwent a rotational motion, which placed a shear stress on the titanium screws that hold the shims to the breech door. The screws sheared off, causing significant leakage, even at the minimal submergence pressure applied to the breech door at the Aberdeen Test Center Underwater Test Facility, resulting in immediately casualty surfacing of the A/B-1 Test Vehicle. A design change was then implemented, and a subsequent shock test was satisfactorily performed. This test demonstrated that shock testing can uncover weaknesses in the design of vital components having major significance in the submarine's function and ability to survive in combat. Such weaknesses in many instances are not costly to correct. Based on this test and similar experiences on USS JACKSONVILLE (SSN 699), similar significant weaknesses affecting the submarine's ability to complete its mission would be uncovered in a SEAWOLF Full Ship Shock Test.

As COMOPTEVFOR recommends, the Navy should budget for and the Congress should fully fund the SEAWOLF class full ship shock test, even if it would now occur after the ship's initial deployment. Live fire testing of platforms such as SEAWOLF reveal deficiencies that were previously undetected, but are relatively easily corrected, and will protect the crew during battle. Although the Navy has resisted shock testing SEAWOLF (on the argument of excessive cost versus the small number of hulls), it has agreed to perform the test if it is funded. DOT&E considers the $47 million price tag reasonable when viewed in the much larger context of SEAWOLF's overall cost and added crew safety margin.

The SEAWOLF submarine class is scheduled to be operationally evaluated in calendar year 2000, and since SEAWOLF is a major defense acquisitions program, DOT&E will assess OT and LFT adequacy, evaluate operational effectiveness and suitability, and submit final test and evaluation reports to Congress as required by Sections 2366 and 2399, title 10, U.S. Code. DOT&E maintains that assessment of operational effectiveness, suitability, and survivability must precede the decision to operationally employ the SEAWOLF Class, but the Navy may deploy the ship before completing all initial OPEVAL testing.

Over the years, the Navy has operationally evaluated its submarine sonars and combat systems, but the SEAWOLF OPEVAL marks the first-ever operational evaluation of an entire submarine. At first glance, this OPEVAL appears to be insignificant, since only three SEAWOLF class submarines will be built, and no immediate production decisions hinge on its outcome—but this is misleading. The follow-on nuclear attack submarine, the VIRGINIA, is being built essentially as a slower, but more affordable submarine with very similar capabilities to SEAWOLF. With this in mind, the SEAWOLF OPEVAL not only is the first-ever ***independent*** look at a U.S. nuclear submarine, but is also the first look at the capabilities of our nuclear attack submarines (*including* VIRGINIA) for the next 25 to 40 or more years. This presents a unique opportunity to identify VIRGINIA problems early, during the SEAWOLF OPEVAL, helping make the VIRGINIA and all the new attack submarines of its class better submarines. Finally, the SEAWOLF needs to be operationally evaluated to better understand her capabilities before she initially deploys as a front-line fleet asset, for reasons cited in the classified version of this report. A much better picture of SEAWOLF's effectiveness, particularly when compared to previous U.S. submarines, should emerge after OPEVAL.